

The Examiner is respectfully requested to amend the above-identified application as follows pursuant to 37 C.F.R. § 1.116:

IN THE CLAIMS:

Please cancel Claims 9, 10, 27 and 28 without prejudice or disclaimer of subject matter. Please amend Claims 1-8, 11-22 and 24 as follows. A marked-up copy of Claims 1-8, 11-22 and 24 showing the changes made thereto, is attached. Note that all the claims currently pending in this application, including those not presently amended, have been reproduced below for the Examiner's convenience.

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1. (Twice Amended) An illumination optical system having a total reflection type light transmitting element, for illuminating a surface to be illuminated, said illumination optical system comprising:

an imaging optical system for forming an image of a light source by use of a light from the light source, and

a light collecting optical system for directing light from the light source image to the light transmitting element and being effective to make the numerical aperture thereof small.

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2. (Twice Amended) An illumination optical system, comprising:
an imaging optical system for forming an image of a light source by use of light from the light source;

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a total reflection type light transmitting element; and
a light directing optical system for directing light from the light source image to said light transmitting element,
wherein the numerical aperture of the light directing optical system on the light transmitting element side thereof is smaller than the numerical aperture of said imaging optical system on the light transmitting element side thereof; and
wherein a surface to be illuminated by said illumination optical system is illuminated with light from the light source as transmitted by said light transmitting element.

3. (Twice Amended) An illumination optical system according to Claim 2, wherein the light source image has an illuminance which is larger in a portion adjacent an optical axis than in a peripheral portion about the optical axis.

4. (Twice Amended) An illumination optical system according to Claim 2, wherein said imaging optical system includes an elliptical mirror, wherein the light source is disposed at one focal point of said elliptical mirror, and wherein the light source image is formed at another focal point of said elliptical mirror.

5. (Twice Amended) An illumination optical system according to Claim 2, wherein the light source comprises a Hg lamp.

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6. (Twice Amended) An illumination optical system according to Claim 2, wherein said imaging optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens unit is disposed substantially in coincidence with the light source image while an exit pupil of the second lens unit is disposed substantially in coincidence with a light entrance surface of said light transmitting element.

7. (Twice Amended) An illumination optical system according to Claim 2, wherein said imaging optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with a light entrance surface of said light transmitting element.

8. (Twice Amended) An illumination optical system according to Claim 2, wherein said imaging optical system includes fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with a light entrance surface of said light transmitting element.

11. (Twice Amended) An illumination optical system for illuminating a surface to be illuminated, by use of an optical fiber bundle, said illumination optical system comprising:

an imaging optical system for forming an image of a light source by use of light from the light source; and

a light collecting optical system for directing light from the light source to the optical fiber bundle and being effective to make the numerical aperture thereof small.

12. (Twice Amended) An illumination optical system, comprising:

an imaging optical system for forming an image of a light source by use of light from the light source; and

an optical fiber bundle; and

a light directing optical system for directing light from the light source image to said optical fiber bundle, wherein the numerical aperture of said light directing optical system on the optical fiber bundle side thereof is smaller than the numerical aperture of said imaging optical system on the optical fiber bundle side thereof;

wherein a surface to be illuminated by said illumination optical system is illuminated with light from the light source as transmitted by said optical fiber bundle.

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13. (Twice Amended) An illumination optical system according to Claim 12, wherein the light source image has an illuminance which is larger in a portion adjacent an optical axis than in a peripheral portion about the optical axis.

14. (Twice Amended) An illumination optical system according to Claim 12, wherein said image optical system includes an elliptical mirror, wherein the light source is disposed at one focal point of said elliptical mirror, and wherein the light source image is formed at another focal point of said elliptical mirror.

15. (Twice Amended) An illumination optical system according to Claim 12, wherein the light source comprises a Hg lamp.

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16. (Twice Amended) An illumination optical system according to Claim 12, wherein said imaging optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens units is disposed substantially in coincidence with the light source image while an exit pupil of the second lens unit is disposed substantially in coincidence with a light entrance surface of said optical fiber bundle.

17. (Amended) An illumination optical system according to Claim 12, wherein said imaging optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the light

source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with a light entrance surface of said optical fiber bundle.

18. (Twice Amended) An illumination optical system according to Claim 12, wherein said imaging optical system includes a fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially in coincidence with the light source image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with a light entrance surface of said optical fiber bundle.

19. (Amended) An illumination optical system according to Claim 12 wherein said optical fiber bundle has a light entrance of one of square shape and rectangular shape, and a light exit face of arcuate shape.

20. (Amended) An illumination optical system according to Claim 12, wherein said optical fiber bundle comprises a total reflection type fiber bundle.

21. (Amended) An illumination optical system according to Claim 12, wherein said optical fiber bundle comprises a distributed refractivity type optical fiber bundle.

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22. (Twice Amended) An illumination optical system, comprising:
light directing means for directing light to a predetermined plane,
wherein the light includes plural light beams to be incident on the predetermined plane at
different angles;
a total reflection type light transmitting element; and
a light directing optical system for directing light from the
predetermined plane to said light transmitting element,
wherein the numerical aperture of the light emitted from said light
directing optical system is smaller than the numerical aperture of the light impinging on the
predetermined plane, and
wherein a surface to be illuminated by said illumination optical
system is illuminated with light from said directing means as transmitted by said light
transmitting element.

23. (Not Amended) An illumination optical system according to Claim
22, wherein said light transmitting element comprises an optical rod.

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24. (Amended) An illumination optical system according to Claim 22,
wherein said directing means comprises a plurality of laser light sources.

25. (Amended) An exposure apparatus, comprising:
an illumination optical system as recited in any one of Claims 1-8
and 11-24; and